

Simulation Xploder-1b

Date: Thursday, August 25, 2016

Designer: Solidworks

Study name: Static 1

Analysis type: Static

Table of Contents

Description	1
Study Properties.....	2
Units	2
Material Properties	3
Loads and Fixtures	3
Contact Information	4
Mesh information.....	5
Resultant Forces.....	6
Study Results.....	7
Conclusion	8

Description

The Xploder device was modeled in Solidworks and analyzed in an assembly that included a simplified model of a barbell end. Both were accurately modeled and assembled to the extent that the method of contact between the two was as realistic as possible. The actual gap between the inner diameter of the Xploder tube and the outer diameter of an Olympic sized barbell was maintained and “no penetration” contact sets were established between the two surfaces to simulate collision. As well the wing nut was modeled and assembled to interact with the barbell. Lastly, the interaction between the end of the barbell and the face of the handle bar within the tube was established to be “no penetration”.

The load is modelled such that the device is being used in a perfectly horizontal position to lift a barbell with plate style weights. The horizontal position is the worst case---given intended use---due to the fact that as soon as the bar is non-horizontal the weight is shared with the hinged end fixture.



Study Properties

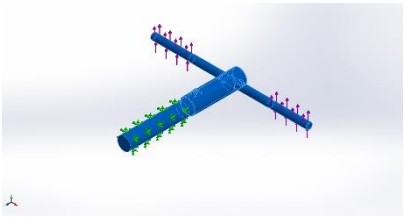
Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\jontw\Desktop\Xploder)

Units

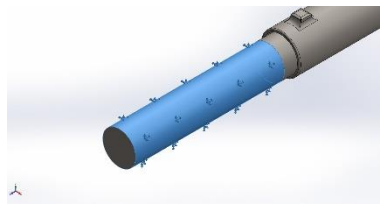
Unit system:	English (IPS)
Length/Displacement	in
Temperature	Fahrenheit
Angular velocity	Hertz
Pressure/Stress	psi



Material Properties

Model Reference	Properties	Components
	Name: ASTM A513 Steel Model type: Linear Elastic Isotropic Default failure criterion: Max von Mises Stress Yield strength: 53186 psi Tensile strength: 76523 psi Elastic modulus: 2.90075e+007 psi Poisson's ratio: 0.26 Mass density: 0.283599 lb/in ³ Shear modulus: 1.15015e+007 psi	SolidBody 1(Boss-Extrude1)(Barbell-1), SolidBody 2(Boss-Extrude2)(Barbell-1), SolidBody 1(Chamfer1)(US-1)
Curve Data:N/A		

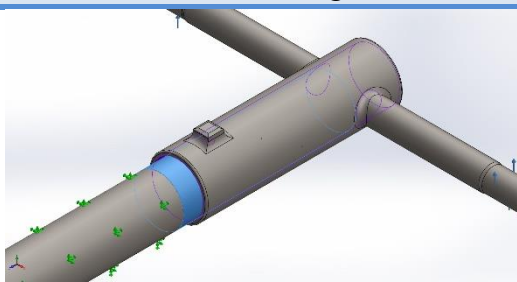
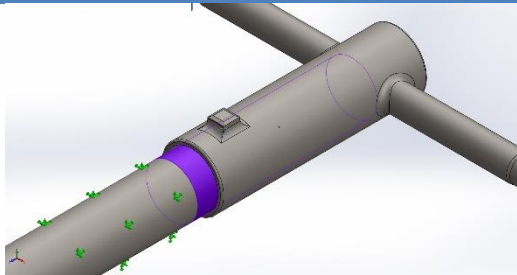
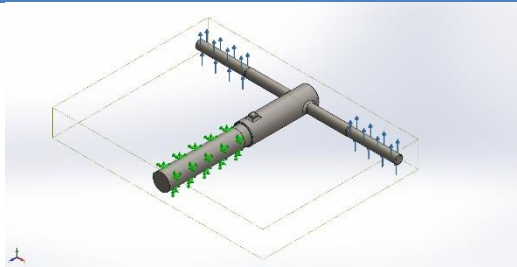
Loads and Fixtures

Fixture name	Fixture Image	Fixture Details		
Fixed-1		Entities: 1 face(s) Type: Fixed Geometry		
Resultant Forces				
Components	X	Y	Z	Resultant
Reaction force(lbf)	3.63399e-005	-1020	-0.000445699	1020
Reaction Moment(lbf.in)	0	0	0	0

Load name	Load Image	Load Details
Force-1		Entities: 2 face(s), 1 plane(s) Reference: Top Plane Type: Apply force Values: ---, ---, 1020 lbf



Contact Information

Contact	Contact Image	Contact Properties		
Contact Set-1		Type: No Penetration contact pair Entites: 2 face(s) Advanced: Node to surface		
Contact/Friction force				
Components	X	Y	Z	Resultant
Contact Force(lbf)	6.3895E-015	-182.69	9.7495E-019	182.69
Contact Set-2		Type: No Penetration contact pair Entites: 2 face(s) Advanced: Node to surface		
Contact/Friction force				
Components	X	Y	Z	Resultant
Contact Force(lbf)	6.6418E-005	1202.7	-1.171E-007	1202.7
Global Contact		Type: Bonded Components: 1 component(s) Options: Compatible mesh		



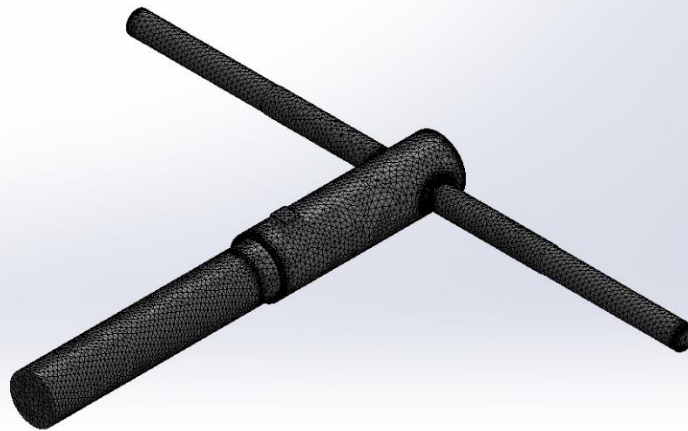
Mesh information

Mesh type	Solid Mesh
Mesher Used:	Curvature-based mesh
Jacobian points	4 Points
Maximum element size	0.2 in
Minimum element size	0.04 in
Mesh Quality	High
Remesh failed parts with incompatible mesh	Off

Mesh information - Details

Total Nodes	175738
Total Elements	110879
Maximum Aspect Ratio	7.8783
% of elements with Aspect Ratio < 3	98.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:08
Computer name:	NPDC-TUL-09-PC

Model name: Assem1
Study name: Static 1 (Default)
Mesh type: Solid Mesh



Mesh Control Information:

Mesh Control Name	Mesh Control Image	Mesh Control Details
Control-1		Entities: 1 edge(s), 2 face(s) Units: in Size: 0.05 Ratio: 1.5

Resultant Forces

Reaction forces

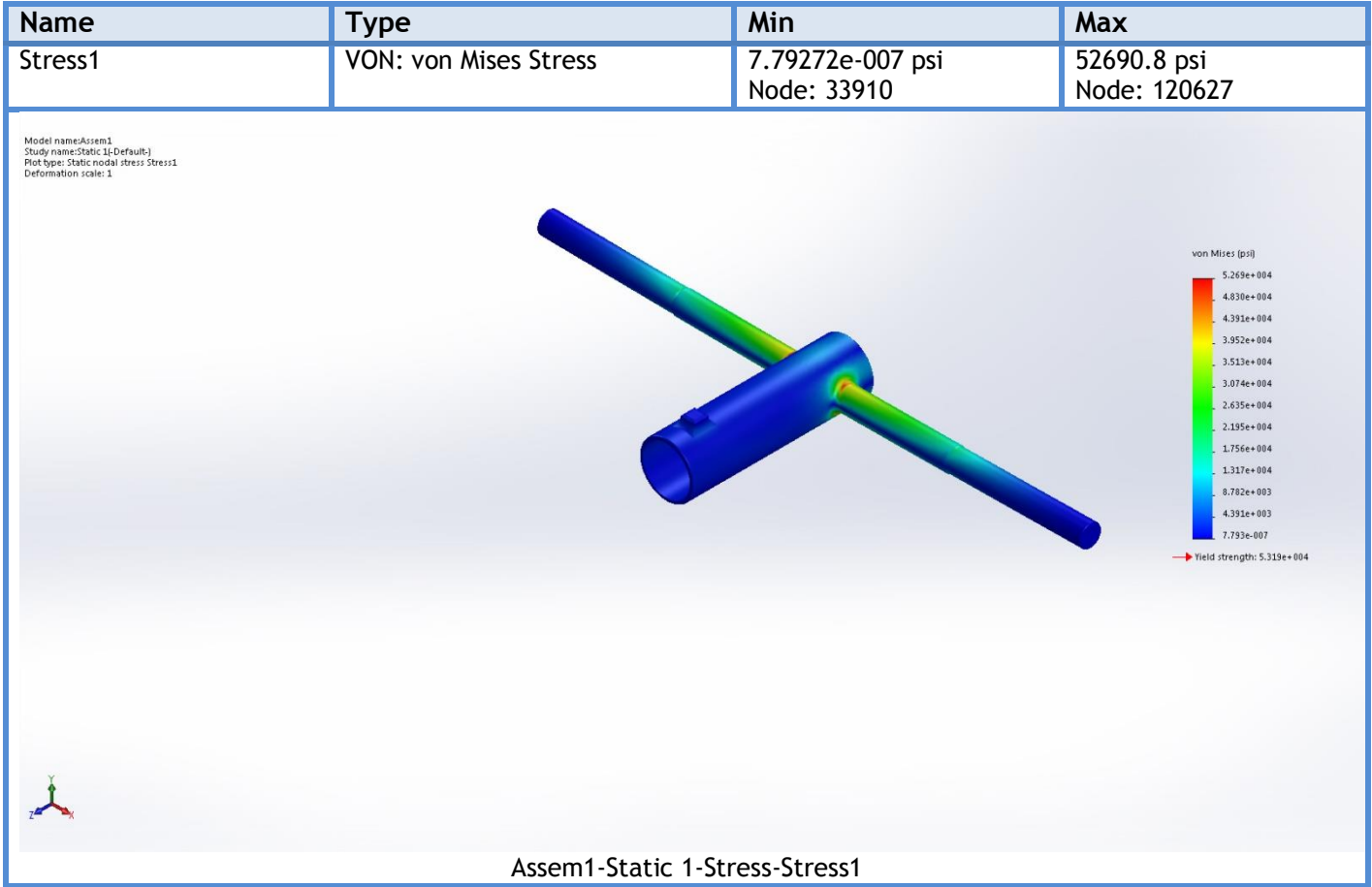
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	lbf	3.63399e-005	-1020	-0.000445699	1020

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	lbf.in	0	0	0	0

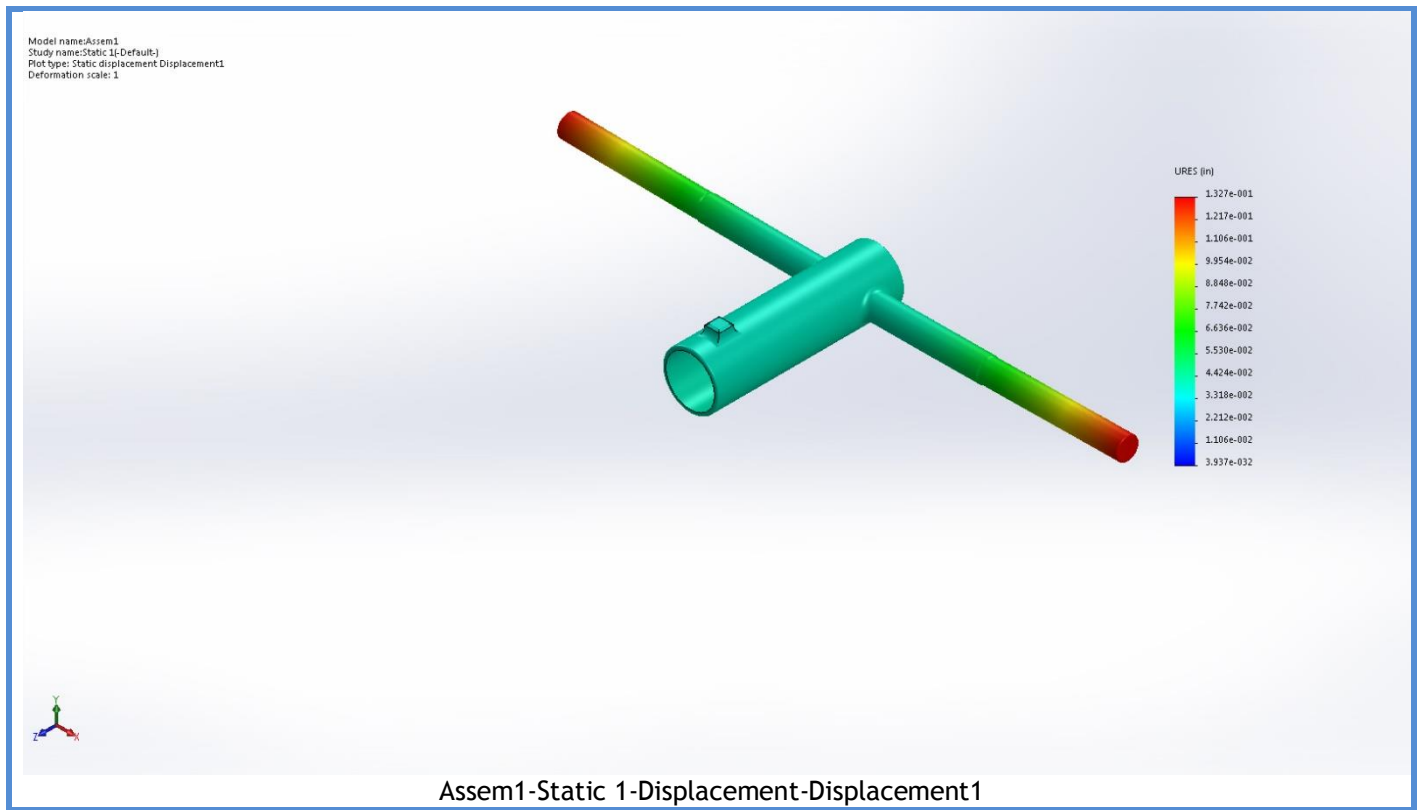


Study Results



Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0 in Node: 1	0.132713 in Node: 123316

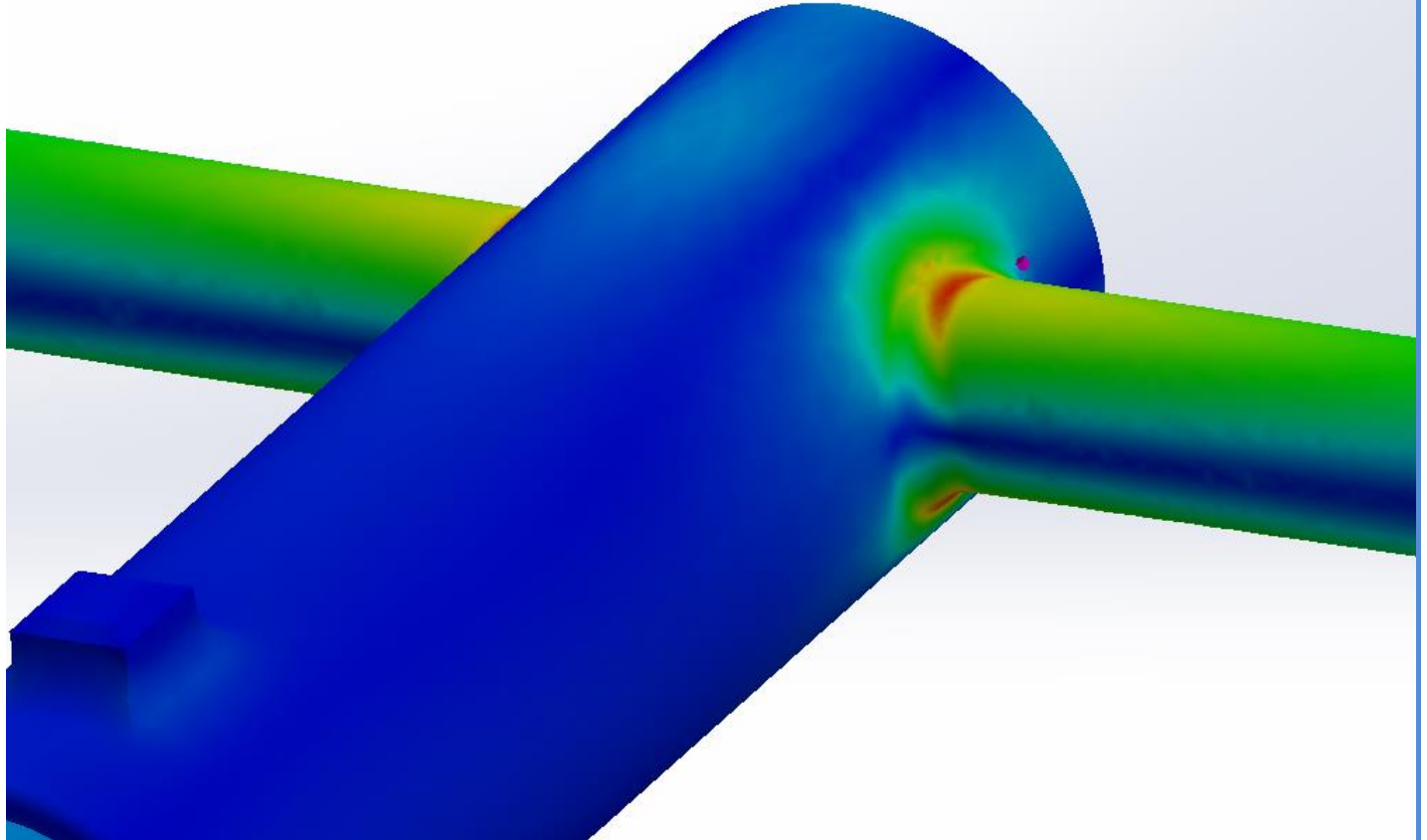




Conclusion

The highest stress is found at the welds around the handle exterior to the tube (as shown in the below figure). Plastic (permanent) deformation will begin to occur with a load of 1020 pounds. Plastic deformation does not mean material failure; it simply means that a component was displaced beyond its elastic capabilities and will have permanent deformation once unloaded. At full load of 1020 pounds the ends of the handles will have displaced less than 0.14”.





Assem1-Static 1-Location of Highest Stress

